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Characteristics of Black Soldier Fly Farmers from Green Supply Chain Management Implementation: A Case Study in Greater Malang, Indonesia

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ABSTRACT: The objective of the study was to determine the characteristics of farmers on black soldier fly farms in Malang Raya, East Java Province, Indonesia. The research was conducted in black soldier fly farms spread across Malang Regency, Malang City, and Batu City for one month from October to November 2023. The method used in the research is a survey with a quantitative approach while the sampling method is snowball sampling (sampling by identifying, selecting and sampling in a network or continuous chain of relationships) and purposive sampling method (data collection with consideration of farm conditions). The data collection method used a survey through interviews, questionnaires, focus group discussions and documentation. Data on farmer characteristics used were data on business scale, age, education, farming experience, and the number of dependents of the farmer's family with a total of 30 respondents. Data analysis using descriptive quantitative. The characteristics of breeders from the results showed that the scale of the breeder's business with the highest percentage of bioponds was 54% (16 people) with a small scale (5-15 bioponds), based on the age of the highest breeders dominated by the age of 31-35 years by 29% (9 people), education dominated by high school graduates by 70% (21 people), breeding experience dominated by 2-2.5 years by 43% (13 people), and the number of family dependents dominated by 4 people by 33% or (10 people). The conclusion is that the characteristics of farmers who implement green supply chain management in the black soldier fly farming business are classified as low business scale, age is classified as productive, education is classified as low, farming experience is still low, and the number of family dependents is classified as medium.

KEYWORD: Farmer Characteristics, Black Soldier Fly, Green Supply Chain Management

I. INTRODUCTION

Malang Raya is an area that covers part of the ex-Malang Karesidenan area consisting of Malang Regency, Malang City and Batu City. The cause of environmental problems in Malang Raya is high waste generation in the form of organic waste such as food scraps. SIPSN (2023) states that the highest to lowest waste composition generated from Malang Raya is food waste (organic waste) 54.39%. The waste generated from Malang City is 284,095.41 tons/year, Malang Regency is 352,927.26 tons/year and Batu City is 52,062.68 tons/year so that the total is 689,085.35 tons/year which is higher than Surabaya City 657,016.64 tons/year which is independently the highest in East Java Province. The impact of accumulated organic waste can decompose and produce methane gas which can cause global warming, cause foul odors, become a nest for insects, rats, and other animals, which has the potential to spread diseases. The above problem shows that the settlement of organic waste can be solved with BSF maggot commodities. BSF maggot is able to decompose organic waste piles. Commercialization of BSF maggot also has a positive impact on the economy of farmers by selling products in the form of fresh maggot, maggot flour and dried maggot as animal feed which reduces feed costs. Kusumaningsih (2023) supports that Black Soldier Fly (BSF) functions to decompose organic waste so as to produce economic value. Commercialization of BSF maggot products cannot be separated from the supply chain management process. Supply chain management in BSF maggot products includes processes from upstream to downstream, namely the process of obtaining BSF maggot eggs to distribution to end consumers. The implementation of conventional supply chain management is not oriented towards environmental sustainability, such as the formation of carbon emissions in the supply chain process.

The development of the livestock business and increasing consumer awareness to protect the environment, encourages BSF maggot farming businesses to adjust activities with the concept of green farming business in every farming business process through the concept of green supply chain management. The implementation of the GSCM strategy in the

BSF maggot farming business aims to minimize or eliminate waste and pollution generated along the supply chain. green supply chain management emerges as a new innovation for BSF maggot farming businesses to implement win-win strategies in gaining profits and market share while still paying attention to ecological aspects or business integration with environmental systems. The green supply chain management activities in the BSF maggot farming business are formed from the upstream part (green procurement), the onfarm part (green farming and green marketing) and the downstream part (green distribution and reverse logistics). The implementation of green supply chain management in the BSF maggot farming business in Malang Raya cannot be guaranteed as a whole because it must first be reviewed by the human resources who will implement it. The human resources that must be reviewed are the characteristics of black soldier fly breeders as producers using research variables, namely business scale, education, age, breeding experience, number of farmer family dependents and will be tabulated using descriptive analysis to describe the data that has been processed so as to produce clear and easy-to-understand information. Research in the form of a case study of farmer characteristics is needed in Malang Raya as information for black soldier fly farmers to develop their livestock business and evaluation material to improve the quality of human resources in the coming year.

II. RESEARCH METHODS

Time, Location and General Situation : The research was conducted on black soldier fly farms from October to November 2023 for one month. The research was conducted in Greater Malang because it is divided into 3 regions namely Malang Regency, Malang City and Batu City, East Java Province, Indonesia with the consideration that Greater Malang is an area that produces the highest waste generation in East Java Province and East Java Province is the region with the highest waste generation from all over Indonesia which is 5,218,266.25 tons/year (National Waste Management Information System, 2023). The waste generation in Greater Malang is higher than Surabaya City in 2023, which shows a difference with the following data:

Table 1. Waste Generation in Greater Malang and Surabaya City in 2023

Greater Malang (tons/year)		Surabaya City (tons/year)
Malang District	352.927,26	
Malang City	284.095,41	657.016,64
Batu City	52.062,68	
Total	689.085,35	657.016,64

Source: National Waste Management Information System (2023).

The National Waste Management Information System (2023) shows that Malang Raya is an area consisting of Malang City, Batu City and Malang Regency within the administrative structure and responsibility of East Java Province, which is experiencing an increase in the amount of waste generation and is the reason for choosing a location in Malang Raya by considering the following:

1. The highest to lowest composition of waste generated from Malang Raya is food waste (organic waste) 54.39%, plastic by 13.66%, wood / framing by 13.6%, other 10.39%, glass by 1.78%, metal by 0.98%, fabric by 0.52%, rubber / leather by 0.21%.
2. The high potential of food waste as organic waste in Malang Raya is a prospective opportunity for the development of BFS maggot farming as feed.
3. The Greater Malang area has many poultry farms which are business opportunities for BSF maggot farmers which are used as a protein source feed with a total population of 2,591,029 native chickens, while laying hens are 4,989,740, broilers are 26,897,950, ducks and manila ducks are 993,833 (Central Bureau of Statistics of East Java Province, 2023).

III. DATA COLLECTION

The research was conducted in Greater Malang which is spread across 3 regions namely Malang Regency, Malang City, and Batu City, East Java Province, Indonesia from October to November 2024. The research method used was a survey method with a quantitative approach. The sampling method used two methods, namely snowball sampling (sampling by identifying, selecting and sampling in a network or chain of continuous relationships) and purposive sampling method (data collection with consideration of farm conditions). Data collection methods used surveys through interviews, questionnaires, focus group discussions and documentation to obtain primary data while data from supporting journals, literature reviews, government agencies and so on. The research variables used in the farmer characteristic data are business scale data, age, education, farming experience, and the number of farmer family dependents with a total of 30 respondents.

Data Analysis : The data analysis used is descriptive analysis. Descriptive analysis is an analysis that describes the data that has been processed so that it produces clear and easy-to-understand information. Descriptive statistics is the process of analyzing data by describing the data that is already available without intending to make general conclusions or generalizations. Measurements can be reviewed from the minimum value, maximum value, most frequently occurring value, average and standard deviation (Sugiyono, 2019). The measurement used is the most frequently occurring value or mode. Mode is the value that appears most often from a set of data (Junaidi, 2014).

IV. RESULTS AND DISCUSSION

Descriptive Analysis of Characteristics of Black Soldier Fly Breeders in Greater Malang : The case study of the characteristics of black soldier fly breeders uses descriptive analysis to describe the data that has been processed so as to produce clear and easy-to-understand information. Case studies of breeder characteristics are needed in Malang Raya as information for black soldier fly breeders to develop their livestock businesses and evaluation materials to improve the quality of human resources in the coming year.

Table 2. Characteristics of Black Soldier Fly Farmers in Greater Malang, East Java Province, Indonesia

No.	Farmer Characteristics	The Number of Respondents (person)	Percentase (%)
1.	Business Scale		
	Small Scale (5-15 bioponds)	16	53
	Medium Scale (16-25 bioponds)	9	30
	Large Scale (26-55 bioponds)	5	17
	Total	30	100
2.	Education		
	Tamat Junior High School	3	10
	Tamat Senior High School	21	70
	Diploma	1	3
	Bachelor	5	17
	Total	30	100
3.	Age		
	25-30 year	7	23
	31-35 year	9	30
	36-40 year	6	20
	41-45 year	5	17
	>46 year	3	10
	Total	30	100
4.	Farming Experience		
	2-2,5 year	13	43
	3 year	8	27
	4 year	5	17
	5 year	4	13
	Total	30	100
5.	Number of Family Dependents		
	1 person	4	13
	2 person	6	20
	3 person	8	27
	4 person	10	33
	>5 person	2	7
	Total	30	100

Sourc**e**: Primary data processed (2024).

Busines Scale : The scale of a BSF maggot farm refers to the relative size of the maggot farming operation, which includes the number of bioponds available. The scale can vary from small-scale farms with a small number of bioponds to medium- and large-scale farms. The scale of BSF maggot farming in Malang Raya has a small-scale population with 5-15 bioponds, a medium-scale population with 16-25 bioponds and a large-scale population with 26-55 bioponds. The results of research on the scale of business owned by maggot farmers in Greater Malang are divided into three regions, namely Malang Regency, Malang City, and Batu City. The business scale owned by farmers is the number of bioponds with the highest percentage of 53% (16 people) for farmers who have 5-15 bioponds, the second percentage of 30% (9 people) for farmers who have 16-25 bioponds, the lowest percentage of 17% (5 people) for farmers who have 26-55 bioponds. The total number of farmers as respondents in the study was 30 people. The scale of BSF maggot farming in Malang Raya is predominantly small-scale. Especially in rural areas, especially in Malang District, there are many limitations. This situation includes BSF maggot rearing practices that still follow traditional patterns, hampered by limited technology for product diversification and limitations in product marketing. Sulistyati (2023) stated that various factors for the low ownership of BSF maggot include limited capital, limited land for cage expansion because it is behind the house.

Education : Education is a learning process that aims to optimize individual abilities such as intelligence, skills, personality, self-awareness, religion, noble character, and a forward-oriented mindset to add self-knowledge and is needed in society. human education can become a quality individual because it has empowered his potential and competence that can be useful during his life. The level of education possessed with a high degree can then elevate a higher and better life in the social class, increasing the standard of living at a higher level than the education taken.The research results of the characteristics of breeders based on education level are very diverse, namely the lowest percentage is dominated by vocational graduates by 3% (1 person), junior high school graduates are dominated by 10% (3 people) with the third highest order category, bachelor graduates are dominated by 17% (5 people) with the second highest order category, senior high school graduates are dominated by 70% (21 people) with the highest order category. The majority of farmers have the lowest level of education, namely high school graduates because many of them do not continue their education to a higher level. A low level of education will certainly narrow the mindset that makes it not develop in thinking (fixed mindset) which should be a growth mindset so that it makes it difficult to change the mindset in the development of livestock businesses because of less qualified resources. As a result, the development of black soldier fly farming will take longer and it is difficult to apply technology because farmers do not or do not understand the information in the technology to be applied. Lestraningsih dan Basuki (2008) supports that the level of education affects the ability of farmers to adopt technology because when the level of education is low, the ability to understand and apply new innovations is limited, so the ability to develop will also be limited compared to farmers who have a higher level of education.

Age : Age is the time used by a person in living life from birth to birthday. Age is a benchmark for a person's strength and maturity in working and thinking. The age of farmers can be grouped into 3 groups, namely (1) age 0 - 14 years, namely young / unproductive age; (2) age 15 - 64 years, namely adult age / productive age / working age; and (3) age 65 years and over, namely old / unproductive age. Age >65 years is referred to as unproductive age because it has exhausted its productive period or elderly (non-productive) whose physical energy begins to weaken. The research results of the characteristics of breeders based on age are very diverse as indicated by the highest percentage of age dominated by 31-35 years of age by 29% (9 people), then for the second highest age dominated by 25-30 years of age by 53% (8 people), the third highest age of 36-40 years by 19% (6 people) and 41-45 years of age by 6% (5 people) and the lowest is age> 46 years (3 people). The five age levels of farmers are included in the productive age category of 15-64 years. Strong physical abilities and energy make farmers in their productive age generally have greater physical abilities and energy to perform the physical tasks required in managing farms, including facing challenges in the BSF maggot farming business that require hard work and quick responses. Openness to innovation and change means that farmers in their productive years are often more open to innovations and changes in farming practices. Farmers may be better able to adopt new technologies or management strategies that can help face future challenges.

Kurnia (2019) supports that at a productive age, a person tends to have an open mind, physical readiness, and accept innovation and technology in developing a BSF maggot farming business because the younger the age of the farmer, the higher the spirit of learning and curiosity about something that is not yet known so that it is faster to accept information, innovation and technology which is not only to develop the livestock business but also to add its own experience because the experience of young farmers is still reduced.

Farming Experience : Farming experience is the period of time that a farmer has spent or lived in running a livestock business and activities as a farmer, measured in years. Longer farming experience reflects better knowledge and skills in implementing BSF maggot rearing management, which indicates the farmer's ability to develop the BSF maggot farming business. Management of BSF maggot rearing includes aspects such as feeding, disease control, health care and hygiene, and cage management. The results of research on the characteristics of farmers based on experience in farming show that maggot farmers have diverse experiences in undergoing the profession as BSF maggot farmers, namely the lowest percentage of farming experience dominated by 5 years of farming experience at 13% (4 people), 4 years of farming experience at 17% (5 people) with the third highest order category, 3 years of farming experience at 27% (8 people) with the second highest order category and 2-2.5 years of farming experience at 43% (13 people) with the highest order category. The highest percentage of breeding experience is dominated by the 2-2.5 year level which is included in the lowest breeding experience in the BSF maggot farming business because some stated that they started the BSF maggot farming business from participating in environmental health competitions, initiatives to manage organic waste, additional income, and as a side job. These reasons make the farming experience of maggot farmers still relatively inexperienced. Gazali (2015) supports that breeding experience of less than 5 years is classified as inexperienced breeders, 5-10 years is considered as moderately experienced, and more than 10 years is considered experienced in the livestock business. Sutawi (2012) concluded that farmers with considerable experience in managing their business tend to have better knowledge, attitudes, and skills than less experienced farmers. The longer experience of a farmer certainly illustrates that the more skills and knowledge in the field of animal science.

Number of Family Dependents : The number of family dependents is all individuals living in one household, including husband, wife, children, and other members, who get food from the head of the family according to the needs of the farmer. Dependents in the family are family members who have a vertical relationship whose lives are borne and become the burden of the head of the family to fulfill all the needs of life. The number of family dependents consists of several categories, namely if the number of dependents above > 5 people is called a large dependency and if the number of dependents is below < 5 people it is called a small dependency. The results of the study of the characteristics of breeders based on the number of family dependents of breeders in the household are very diverse, namely the percentage of the highest number of family dependents of breeders is dominated by the level of family dependents of 4 people by 33% or (10 people), the number of family dependents of 3 people by 27% (8 people) with the second highest order category, the number of family dependents of 2 people by 20% (6 people) with the third highest order category, the number of family dependents of 1 person by 13% (4 people) with the fourth highest order category, and the number of family dependents of 1 person by 7% (2 people) with the lowest order category. The highest percentage in the number of family dependents of 4 people in one BSF maggot farmer household certainly reduces the farmer's income because they have to bear the living needs of each person. Family size has a significant impact on the needs that must be met, encouraging farmers to look for additional sources of income or even become a maggot farming business as a side job.

Nurdiyansah et al. (2020) said that the number of family dependents can also help breeders in terms of labor, because if there are many family members, the lighter the breeder in conducting livestock business because it is assisted by family labor. Sumbayak (2006) said on the other hand that the number of family members will also affect farmers in business development because the more the number of family dependents, the more the burden of life that must be borne by a farmer.

V. CONCLUSION

The characteristics of farmers who implement green supply chain management in black soldier fly farming are classified as low business scale, productive age, low education, low farming experience, and medium number of family dependents.

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